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ASTRONOMICAL DATA IN MACHINE READABLE FORM

by

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This *Circular* supersedes *Circular* 111, 14 January 1966. It contains a revised list, with occasional changes in item number, of the astronomical data available in machine readable form from the U. S. Naval Observatory. Duplicates of these data, on punched cards or magnetic tape, will be made in response to requests from astronomical observatories or other scientific laboratories. Inquiries relative to procurement of copies should be directed to the Superintendent, U. S. Naval Observatory, Washington, D. C. 20390.

(1) *The American Ephemeris and Nautical Almanac*

(a) Through 1980: Daily values at 0^h E. T. of: apparent right ascension and declination, radius vector, semidiameter. Equation of time through 1967; ephemeris transit beginning 1968 (365 cards per year).
(b) 1968–80: Daily values at 0^h E. T. of: longitude (mean equinox of year), reduction to apparent longitude, latitude (ecliptic of 1950.0, year, and date), horizontal parallax, precession in longitude, nutation in longitude and obliquity of ecliptic (365 cards per year).
(c) Ephemeris for physical observations, through 1970 (365 cards per year).

(2) *Astronomical Papers,* Vol. XIV

(a) left hand pages: spherical and rectangular coordinates of the Earth–Moon barycenter referred to 1950.0, 1800–2000 (23,000 cards); tapes available in 4, 10, and 20 day intervals.
(b) right hand pages: geocentric spherical (referred to date) and rectangular (referred to 1950.0) coordinates of the Sun, 1800–2000 (19,000 cards).

(3) Geocentric equatorial rectangular coordinates in units of Earth's radius

(a) referred to mean equinox of nearest beginning of year, every 2 days, 1957 December 16 through 1971 January 13 (2400 cards),
(b) referred to 1950.0, every 2 days, 1957 December 15 through 1971 January 12 (2400 cards),
(c) referred to 1963.0, daily, 1959 January 1 through 1971 January 12 (4800 cards).

(4) Apparent longitude, referred to true equinox of date

(a) for every 10 days, 100 B. C. – A. D. 1800 (7,000 cards),
(b) daily, 1850 – 2000. Magnetic tape only.

(5) *Publications of the U. S. Naval Observatory*

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle

(a) Vol. XVI
    (1) Part I, 1925 – 1941 (7,615 cards).
    (2) Part III, 1941– 1949 (2,565 cards).
(b) Vol. XIX
    (1) Part I, 1949 – 1956 (3,043 cards).

(6) *U. S. Naval Observatory Circulars* Nos. 103, 105 and 108

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle between 1956 and 24 December 1964 (4,220 cards).

Also see Miscellaneous: *The Nautical Almanac,* right hand pages and *The Air Almanac.*

(1) *The American Ephemeris and Nautical Almanac* and *Improved Lunar Ephemeris*, 1952–1959

(a) Apparent longitude and latitude, semidiameter, horizontal parallax, ephemeris transit, for every half day through 1971. Includes nutation and aberration (730 cards per year).
(b) Apparent right ascension and declination, horizontal parallax, hourly through 1971 (8,800 cards per year). Also available on magnetic tape, blocked 24 per record.
(c) Ephemeris for physical observations, through 1970 (365 cards per year).

(2) *The Nautical Almanac*, right hand pages: Greenwich hour angle, apparent declination, horizontal parallax, sidereal time, hourly through 1968 (8,800 cards per year).

(3) Geocentric equatorial rectangular coordinates in units of Earth's radius for every half day, 1952 January 1 through 1971 July 4

(a) referred to mean equinox of nearest beginning of year, as published in *U. S. Naval Observatory Circular* No. 91, *Rectangular Coordinates of the Moon*, 1952–1971 (730 cards per year),
(b) referred to 1950.0 (730 cards per year),
(c) referred to 1963.0 (730 cards per year).

(4) Longitude, latitude, horizontal parallax, referred to mean equinox of date for every half day through 1971. Includes aberration except for the term, $+0''.018 \cos(l - 2D) + 0''.007 \cos 2D$ of the aberration (730 cards per year).

(5) Longitude, latitude, horizontal parallax, semidiameter, obliquity, nutation in longitude, nutation in obliquity, referred to mean equinox of date for every half day, 1850–1999, inclusive. Includes aberration. On magnetic tape only, six reels: (a) 1850–1874, (b) 1875–1899, (c) 1900–1924, (d) 1925–1949, (e) 1950–1974, (f) 1975–1999. In preparation.

(6) Apparent longitude and latitude, referred to true equinox of date, daily, 300 B. C. – A. D. 2074. Magnetic tape only.

(7) *Publications of the U. S. Naval Observatory*

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle

(a) Vol. XVI
(1) Part I, 1925 – 1941 (7,615 cards).
(2) Part III, 1941 – 1949 (2,565 cards).
(b) Vol. XIX
(1) Part I, 1949 – 1956 (3,043 cards).

(8) *U. S. Naval Observatory Circulars* Nos. 103, 105 and 108

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle between 1956 and 24 December 1964 (4,220 cards).

Also see Miscellaneous: *The Nautical Almanac*, right hand pages and *The Air Almanac*.

Planets

(1) *The American Ephemeris and Nautical Almanac*

(a) Apparent right ascension and declination, semidiameter, horizontal parallax, true distance from Earth, ephemeris transit, daily through 1967. All planets except Pluto (365 cards per year per planet).

(b) Apparent right ascension and declination, true distance from Earth and ephemeris transit, daily, 1968–1980, inclusive. All planets except Pluto (365 cards per year per planet).

(c) Astrometric right ascension and declination, horizontal parallax, true distance from Earth, ephemeris transit of Pluto, for every 4 days through 1971 (92 cards per year).

(d) Heliocentric longitude and latitude, radius vector, orbital longitude, daily motion of orbital longitude of Jupiter and Saturn, referred to mean equinox and ecliptic of date, for every 10 days, 1960 May 7 through 1982 January 31 (801 cards per planet).

(e) Heliocentric longitude and latitude, radius vector, orbital longitude, daily motion of orbital longitude of Uranus, Neptune and Pluto, referred to mean equinox and ecliptic of date, for every 40 days, 1959 December 18 through 1982 (205 cards per planet).

(f) Ephemeris for physical observations of Mercury, Venus, Mars, Jupiter and Saturn through 1970.

(2) *Astronomical Papers*, Vol. XII, *Coordinates of the Five Outer Planets*, 1653–2060

(a) 40–day values (3,721 cards per planet).

(b) 10–day values, subtabulated from 40–day coordinates, by date and planet. Magnetic tape only.

(c) 40–day values, by date and planet. Magnetic tape only.

(3) *Astronomical Papers*, Vol. XV, Part III, *Heliocentric Coordinates of Venus*, 1800–2000

(a) 4–day values (41,000 cards).

(b) 4–day values, blocked 10 to a record. Magnetic tape only.

(c) 10–day values, unblocked. Magnetic tape only.

(d) 20–day values, blocked 10 to a record. Magnetic tape only.

(4) *U. S. Naval Observatory Circulars* Nos. 90 and 95

Provisional ephemeris of Mars based on Clemence's theory. Heliocentric equatorial rectangular coordinates, referred to mean equinox and equator of 1950.0, for every 4 days (a) 1800–1950 (tape only), (b) 1950–2000 (2,350 cards).

(5) *U. S. Naval Observatory Circular* No. 96

Geocentric distance and velocity of Venus referred to 1950.0, daily, 1960–1970, inclusive (365 cards per year).

(6) *U. S. Naval Observatory Circular* No. 98

Physical ephemeris of Mars based on a position of the north pole of $\alpha = 316^{\circ}.55 + 0^{\circ}.006533\,(t - 1905.0)$, $\delta = +52^{\circ}.85 + 0^{\circ}.003542\,(t - 1905.0)$, computed at a two day interval for sixty days centered at each opposition from 1877–1967 (5,246 cards).

(7) *Planetary Co–ordinates*, 1960–1980

(a) Heliocentric equatorial rectangular coordinates of Mercury, referred to 1950.0, for every 5 days (365 cards).

(b) Longitude, latitude, radius vector and equatorial rectangular coordinates of Venus, Earth and Mars, referred to 1950.0, for every 10 days (769 cards per planet).

Planets

(8) Heliocentric equatorial rectangular coordinates and first derivatives of Venus and Earth–Moon barycenter, referred to 1950.0 daily, 1960–1970, inclusive

(a) Coordinates (365 cards per year).
(b) Derivatives (365 cards per year).

(9) Longitude, latitude and radius vector of Mercury, Venus and Mars, daily through 1980 (365 cards per year per planet).

(10) (a) Heliocentric equatorial rectangular coordinates of all planets except Mercury, referred to 1950.0, by date and planet, for every 10 days 1800 January 4.5 through 2000 December 2.0. Venus, same as 3(c); Earth–Moon barycenter, same as Sun, 2(a); Mars, unpublished Herget integration; outer planets, same as 2(b). Magnetic tape only.
(b) Same as 10(a) but in reverse chronological order. Magnetic tape only.

(11) *Publications of the U. S. Naval Observatory*

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle

(a) Vol. XVI
(1) Part I, 1925 – 1941 (7,615 cards).
(2) Part III, 1941 – 1949 (2,565 cards).
(b) Vol. XIX
(1) Part I, 1949 – 1956 (3,043 cards).

(12) *U. S. Naval Observatory Circulars* Nos. 103, 105 and 108

Positions of the sun, moon and planets observed with the Six–Inch Transit Circle between 1956 and 24 December 1964 (4,220 cards).

(13) *U. S. Naval Observatory Circular* No. 106

Rectangular co–ordinates of Mercury, 1800–2000. Magnetic tape only.

Also see Miscellaneous: *The Nautical Almanac*, left hand pages and *The Air Almanac*.

Minor Planets

(1) *The American Ephemeris and Nautical Almanac*

Astrometric right ascension and declination, true distance from Earth, ephemeris transit of Ceres, Pallas, Juno, Vesta, daily through 1971 (365 cards per year per planet).

(2) *Astronomical Papers*, Vol. XI, Part IV and Vol. XVI, Part III

Heliocentric equatorial rectangular coordinates of Ceres, Pallas, Juno and Vesta, referred to 1950.0 for every 20 days, 1920–1960 (770 cards per planet); for every 10 days, 1960–1980 (770 cards per planet).

Star Catalogues

Available

(1) *Publications of the United States Naval Observatory*

- (a) Vol. VIII (1,201 cards).
- (b) Vol. IX
  - (1) Part I (4,526 cards).
  - (2) Part IV (196 cards).
- (c) Vol. X, Part I (368 cards).
- (d) Vol. XI
  - (1) Catalogue of 215 Stars (215 cards).
  - (2) Catalogue of 2,499 Stars (2,499 cards).
- (e) Vol. XIII
  - (1) (10,571 cards).
  - (2) Appendix II (818 cards).
- (f) Vol. XIV
  - (1) Part I (3,520 cards).
  - (2) Part II (1,248 cards).
  - (3) Part III (2,094 cards).
- (g) Vol. XV, Part V (5,446 cards).
- (h) Vol. XVI
  - (1) Part I
    - (a) Stars for 1925.0 (2,383 cards).
    - (b) Stars for 1950.0 (1,536 cards).
  - (2) Part III (5,216 cards).
- (i) Vol. XIX, Part I (5,965 cards).

(2) *Astronomical Papers*, Vol. XIII, Part III, N30 (5,268 cards).

(3) Boss, *Albany General Catalogue* (33,342 cards).

(4) Cross References:

- (a) Boss Catalogue star number, Henry Draper star number (3,335 cards).
- (b) Boss Catalogue star number, Henry Draper star number, FK3 star number, Durchmusterung number (33,342 cards).
- (c) Same as 4 (b) but in order of Henry Draper number. Magnetic tape only.

(5) Yale Observatory Catalogues

Declinations	Cards	Declinations	Cards
$+55^\circ$ to $+60^\circ$	8,164	-2° to $+1^\circ$	5,583
$+50^\circ$ to $+55^\circ$	8,380	-2° to -6°	8,108
		-6° to -10°	8,248
$+25^\circ$ to $+30^\circ$	10,358	-10° to -14°	8,101
$+20^\circ$ to $+25^\circ$	8,703	-14° to -18°	8,563
$+15^\circ$ to $+20^\circ$	9,092	-18° to -20°	4,553
$+10^\circ$ to $+15^\circ$	8,967	-20° to -22°	4,292
$+9^\circ$ to $+10^\circ$	1,906	-22° to -27°	15,110
$+5^\circ$ to $+9^\circ$	9,060	-27° to -30°	9,455
$+1^\circ$ to $+5^\circ$	7,996		

Available

(6) Yale Catalogue of Bright Stars (Third Revised Edition, 1964). Magnetic tape only.

(7) Wilson, *General Catalogue of Stellar Radial Velocities*, 1953 (15,106 cards).

(8) FK3

(a) Right ascension (1,591 cards).
(b) Declination (1,591 cards).

(9) FK4 (1,535 cards).

(10) AGK2

Declinations	Cards	Declinations	Cards
$+70^\circ$ to $+89^\circ$	11,801	$+25^\circ$ to $+29^\circ$	14,367
$+60^\circ$ to $+69^\circ$	13,064	$+20^\circ$ to $+24^\circ$	12,992
$+55^\circ$ to $+59^\circ$	8,535	$+15^\circ$ to $+19^\circ$	12,857
$+50^\circ$ to $+54^\circ$	9,168	$+10^\circ$ to $+14^\circ$	14,330
$+45^\circ$ to $+49^\circ$	10,915	$+5^\circ$ to $+9^\circ$	16,770
$+40^\circ$ to $+44^\circ$	11,806	0° to $+4^\circ$	15,094
$+35^\circ$ to $+39^\circ$	12,337	0° to -2.5°	7,157
$+30^\circ$ to $+34^\circ$	12,395		

(11) *Geschichte des Fixsternhimmels*, δ 0° to $+90^\circ$, for 1875 (tape only).

(12) Kustner, Catalogue of 10,663 Stars. Bonn, Vol. 10, δ 0° to $+51^\circ$ (10,663 cards).

(13) Berlin, Vol. 55, AGK2A (13,747 cards).

(14) *Cape Zone Catalogue for* 1900

(a) δ -40° to -52° (20,843 cards).
(b) Also precessed to 1950.0 (20,843 cards).

(15) *Cape Photographic Catalogue for* 1950

Declinations	Cards	Declinations	Cards
-30° to -35°	12,846	-56° to -60°	7,657
-35° to -40°	12,115	-60° to -64°	7,053
-52° to -56°	9,215		

(16) First Cape Catalogue for 1925 (4,569 cards).

(17) Second Cape Catalogue for 1925 (11,667 cards).

(18) Third Cape Catalogue for 1925, δ 0° to -30° (6,597 cards).

(19) First Cape Catalogue for 1950 (5,070 cards).

(20) Semirot, Bordeaux Meridian Circle Observations, δ $+11^\circ$ to $+18^\circ$ (2,024 cards).

(21) Fayet, Meridian Circle at Nice, δ $+5^\circ$ to $+15^\circ$ (964 cards).

In Preparation

(22) Second Washington Catalogue for 1875 (5,429 cards).

(23) Yale, *General Catalogue of Trigonometric Stellar Parallaxes*, 1952 (6,080 cards).

(24) Publications of Pulkova Observatory, Vol. LXII

(a) Left hand pages (587 cards).
(b) Right hand pages (587 cards).

(25) Kukarkin, General Catalogue of Variable Stars

(a) Second edition (14,708 cards).
(b) First supplement to the second edition:
(1) (1,647 cards).
(2) (796 cards).

(26) *Albany Catalogue* for 1910.0 (20,811 cards).

Appendix (1,125 cards).

(27) Boss, *Preliminary General Catalogue of* 6,188 *Stars* for 1900 (6,188 cards).

(28) *Cape Photographic Catalogue for* 1950

Declinations	Cards
-76° to -80°	2,934
-72° to -76°	3,764
-68° to -72°	4,503
-64° to -68°	5,398

(29) Boss, *San Luis Catalogue for* 1910 (15,333 cards).

(30) Cordoba Fundamental General Catalogue for 1950.0 (761 cards).

(31) *Astronomical Papers*

(a) Vol. VIII

(1) Part II (1,596 cards).
(2) Part III (1,607 cards).

(b) Vol. X (1,504 cards).

(32) *Cape Fundamental Catalogue for* 1900 (1,293 cards).

(33) *Second Cape Fundamental Catalogue for* 1900 (1,846 cards).

(34) *Cape General Catalogue for* 1900 (4,464 cards).

(35) *Cape Catalogue of* 1680 *Stars for* 1900 (1,680 cards).

Miscellaneous

(1) Sidereal Time, through 1980 (366 cards per year).

(2) Equation of Time for 0^h U. T., 1965–1970 (62 cards per year).

(3) Nutation in longitude and obliquity, 1949 March 25 through 2009 June 18 (365 cards per year).

(4) Besselian and Independent Day Numbers, 1960–1971

- (a) referred to equinox of 1950.0 (365 cards per year).
- (b) referred to nearest beginning of a year (365 cards per year).

(5) *The Nautical Almanac*, 1964 through 1969

- (a) Left hand pages: Greenwich hour angle and declination of Venus, Mars, Jupiter and Saturn, hourly; sidereal hour angle and declination of 57 stars for every third day (9,000 cards per year).
- (b) Right hand pages: Greenwich hour angle and declination of Sun and Moon, hourly; sunrise–sunset, civil and nautical twilight, moonrise–moonset (9,000 cards per year).

(6) *The Air Almanac*, 1964–1968 (53,000 cards per year).

Coordinates

Geocentric equatorial spherical

Sun (1a) (5a) (5b) (6)
Moon (1b) (7a) (7b) (8)
Planets (1a) (1b) (1c) (11a) (11b) (12)
Minor Planets (1)
The Nautical Almanac [Miscellaneous (4a) (4b)]
The Air Almanac [Miscellaneous (5)]

Geocentric equatorial rectangular

Sun (2b) (3a) (3b) (3c)
Moon (3a) (3b) (3c)

Geocentric ecliptic spherical

Sun (1b) (2b)
Moon (1a) (4) (5)

Heliocentric equatorial rectangular

Earth–Moon barycenter [Sun (2a)]
Planets (2a) (2b) (2c) (3b) (3c) (3d) (4)
(7a) (7b) (8a) (8b) (10a) (10b) (13)

Heliocentric ecliptic spherical

Earth–Moon barycenter [Sun (2a)]
Planets (1d) (1e) (3a) (7b) (9)